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# HIV prevalence in pregnant women and vertical transmission in according to socioeconomic status, Southeastern Brazil

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## ABSTRACT

**OBJECTIVE:** To describe HIV prevalence in pregnant women and the rate of vertical transmission according to socioeconomic status of residential neighborhoods.

**METHODS:** Ecological exploratory study, which used the Information System of Notifiable Diseases database on HIV-positive pregnant women and AIDS in children, reported from 2000 to 2006, in Vitória, Southeastern Brazil. For analysis of socioeconomic data the Urban Quality Index was utilized. The HIV prevalence rate in pregnant women and vertical transmission rate were calculated. Spatial distribution was carried out by Terraview 3.2.0. To verify the association between urban quality and HIV prevalence in pregnant women, Poisson regression was used.

**RESULTS:** A total of 137 HIV-positive women and 14 children infected by vertical transmission was reported. Seven children matched to HIV-positive mothers without notification in the period analyzed. HIV prevalence among pregnant women in the period was 0.44%, and the vertical transmission rate was 9.7%.

**CONCLUSIONS:** The prevalence of HIV infection among pregnant women and vertical transmission were associated with the urban quality of residential neighborhood. Neighborhoods with lower urban quality should be prioritized in actions to reduce vertical transmission.

**DESCRIPTORS:** Pregnant Women. HIV Infections, epidemiology. Infectious Disease Transmission, Vertical, prevention & control.

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## INTRODUCTION

The AIDS epidemic appears to have stabilized in Brazil, although at a high level. Incidence rates were 18.7 cases per 100,000 residents in 1998 and 10.0 cases in 2008.<sup>a</sup>

The epidemic is growing among women, characteristic of the feminization of AIDS.<sup>9,a</sup> Since people of reproductive age are most affected by the infection, the number of children infected by vertical transmission (VT) is high. Vertical transmission involves the transmission of the virus from mother to child, during gestation, birth or breastfeeding.<sup>7,11,b</sup>

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<sup>a</sup> Ministério da Saúde. Secretaria de Vigilância em Saúde. Programa Nacional de DST e Aids. Boletim Epidemiológico Aids e DST. Brasília, DF; 2010.

<sup>b</sup> Ministério da Saúde. Secretaria de Vigilância em Saúde. Programa Nacional de DST e Aids. Recomendações para profilaxia da transmissão vertical do HIV e terapia anti-retroviral em gestantes. Brasília, DF; 2007.

The probability of VT can reach 25.5% without any intervention, but preventative interventions can reduce the transmission level to between zero and 2.0%.<sup>7,b</sup> A study in 2009, with a representative sample of pregnant Brazilian women between ages 15 and 49 years, reported an HIV prevalence of 0.42% at delivery, which corresponds to 13 thousand infected women in 3 million annual pregnancies.<sup>17</sup> In Espírito Santo State (Southeastern Brazil), from 1985 to 2008, 329 AIDS cases were reported among children age less than 13 years, with VT responsible for 310 (94.2%) cases.<sup>c</sup> In the capital Vitória, a 2005 study reported a VT rate of 3.1%.<sup>15</sup>

Understanding the distribution of HIV-infected pregnant women in the community is necessary to estimate risk of VT and guide preventive measures. Inclusion of geographic information in the study allows for visualization of the spatial distribution of cases and improves analysis of relationships between environment and development of infections.<sup>1-3</sup> The study objective was to describe the relationship between HIV infection in pregnant women and VT, according to socioeconomic profile of the mother's residential neighborhood.

## METHODS

An exploratory ecologic study was performed in Vitória, between 2000 and 2006. The city has a land area of 93,381 km<sup>2</sup> and is divided in 79 neighborhoods, which were the unit of analysis.

Population information was obtained from the Municipal Health Secretary of Vitória (SEMUS) and from the *Instituto Brasileiro de Geografia e Estatística* (IBGE – Brazilian Institute of Geography and Statistics), from the 2000 Census. Socioeconomic information was summarized by the Urban Quality Index (IQU) developed by the Institute of Study, Training and Assistance in Social Sciences.<sup>d</sup> It is a descriptive and quantitative indicator composed of various simple indicators, expressed on a scale of 0 to 1, where larger values indicate better quality of life. The index was categorized as low (IQU under 0.54), medium (IQU between 0.54 and 0.62) and high (IQU equal to or greater than 0.63).<sup>5,d</sup>

Epidemiologic data was obtained from forms reporting HIV-positive pregnant women. Data of children less than 13 with an AIDS diagnosis was obtained from the respective reports. These cases were linked to cases of mothers, by searching reports of HIV-positive pregnant women in the period from 2000 to 2006. These data

were made available by SEMUS, using notification/investigation forms from the *Sistema de Informações de Agravos de Notificação* (SINAN – Information System of Notifiable Conditions). Data was entered in an electronic worksheet on Excel®, and prevalence rates were calculated with Stata version 9.0.

The prevalence of infected pregnant women was calculated. The number of reported cases in each neighborhood was divided by the respective population of pregnant women, estimated by the number of live births<sup>6</sup> in the study years and multiplied by 100. To analyze the spatial distribution of HIV cases among pregnant women by neighborhood, average prevalence rates were calculated.

To calculate the VT rate, the numerator was the number of reported AIDS cases in the municipality among children less than 13 years. The denominator was the number of HIV-infected pregnant women over the period multiplied by 100. Due to the discrepancy in the denominator of pregnant women identified in the database of HIV-positive pregnant women and the database of AIDS in children age less than 13 years, it was necessary to utilize two formulas to analyze the VT rate in Vitória. The first formula used the 14 cases of children less than 13 years reported as HIV-positive in the respective SINAN database, with an increase in the denominator of seven mothers not yet reported as HIV-positive pregnant women during the period. The second formula utilized seven reported children in the numerator and the respective mothers as the denominator.

Spatial distribution of events was performed with geoprocessing software TerraView 3.2.0, and the unit of analysis corresponded to neighborhoods in the municipality, whose limits are well-defined.<sup>e</sup>

To evaluate the association between IQU and prevalence of HIV-infection in pregnant women, Poisson regression was performed with Stata 9.0. To relate IQU of residential neighborhood with reports of AIDS in children less than 13 years, it was necessary to perform two analysis: one considering 14 reports and the other considering seven.

The study was approved in May 2008 by the Ethics Committee of the Health Sciences Center of the Universidade Federal de Espírito Santo, and access to the database was authorized by SEMUS (process No 490/2008). In data worksheets, cases were only identified by a registry code, to preserve confidentiality and privacy.

<sup>c</sup> Secretaria Estadual de Saúde do Espírito Santo. Boletim Epidemiológico DST/Aids. A vida é mais forte que a Aids. Vitória: Secretaria Estadual de Saúde; 2009 [cited 2010 Nov 19]. Available from: [http://www.saude.es.gov.br/./dados\\_epidemiologicos\\_aids\\_dez\\_08.doc](http://www.saude.es.gov.br/./dados_epidemiologicos_aids_dez_08.doc)

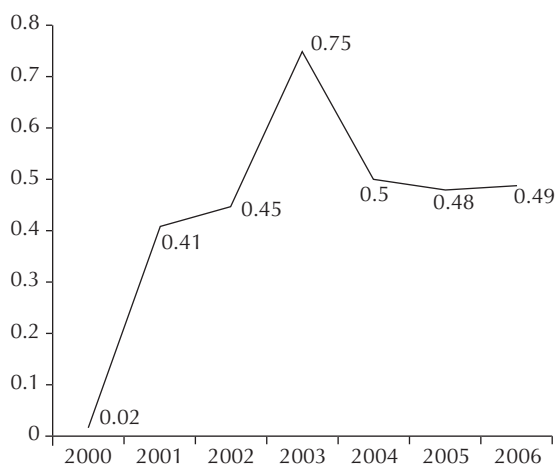
<sup>d</sup> Prefeitura Municipal de Vitória. Coordenadoria de Planejamento. Índice de Qualidade Urbana (IQU) dos bairros de Vitória – 1991 e 2000. Vitória; 2004.

<sup>e</sup> Ministério da Saúde. Secretaria de Vigilância em Saúde. Introdução à estatística espacial para a saúde pública. Brasília, DF; 2007.

**RESULTS**

Between 2000 and 2006, of a total 30,854 pregnant women, 137 (0.44%) were infected with HIV. In general, prevalence varied little (0.41% to 0.50%) each year. The exceptions were 2000 (0.02%) and 2003 (0.75%), when prevalence was far higher than the average over the study period (Figure 1).

During the study period, 14 cases of HIV infection from VT were reported in children, of which only



**Figure 1.** Trend in HIV-infection among pregnant women. Vitória, Southeastern Brazil, 2000-2006.

**Table 1.** Distribution of HIV-positive pregnant women reported, according to sociodemographic characteristics. Vitória, Southeastern Brazil, 2000-2006.

| Characteristics   | n  | %    |
|-------------------|----|------|
| Race/skin color   |    |      |
| White             | 28 | 27.7 |
| Mixed             | 39 | 38.6 |
| Black             | 34 | 33.7 |
| Education (years) |    |      |
| Illiterate        | 8  | 9.3  |
| 1 to 3            | 9  | 10.5 |
| 4 to 7            | 41 | 47.6 |
| 8 to 11           | 26 | 30.3 |
| 12 and more       | 2  | 2.3  |

seven had mothers reported as HIV-positive. The two VT rates calculated were 9.7% and 5.0%. The first rate considered the 14 children against 144 (137 + 7 unreported mothers); the second rate used the seven reported children and 137 mothers as the denominator.

Between 2000 and 2006, 137 cases of HIV-positive pregnant women were reported among residents of Vitória. Some cases were missing information about skin color (26.3%) and education (37.2%). Age varied between 13 and 43 years, with an average of 24.3 years and SD of 5.7 years. For the total 101 women with data for race/color, 39 (33.7%) were brown, 34 (38.6%) black and 28 (27.7%) white. Education data was missing for 51 cases (37.2%), and among the others (86), 41 women (47.6%) studied between 4 and 7 years, 26 (30.3%) studied between 8 and 11 years and 8 (9.3%) were illiterate (Table 1).

Average age of children at time of notification was 18 months (SD 14.2). Only nine (64.3%) had information for race/color (two white, three black and four brown).

Of the 79 neighborhoods in Vitória Municipality, ten reported VT in the study period. Seven neighborhoods presented one case of VT; two cases were reported in the city center and the Maruípe neighborhood; and São Pedro neighborhood presented three cases.

IQU distribution by neighborhoods in Vitória was heterogeneous, with low and high IQU neighborhoods next to each other (Figure 2).

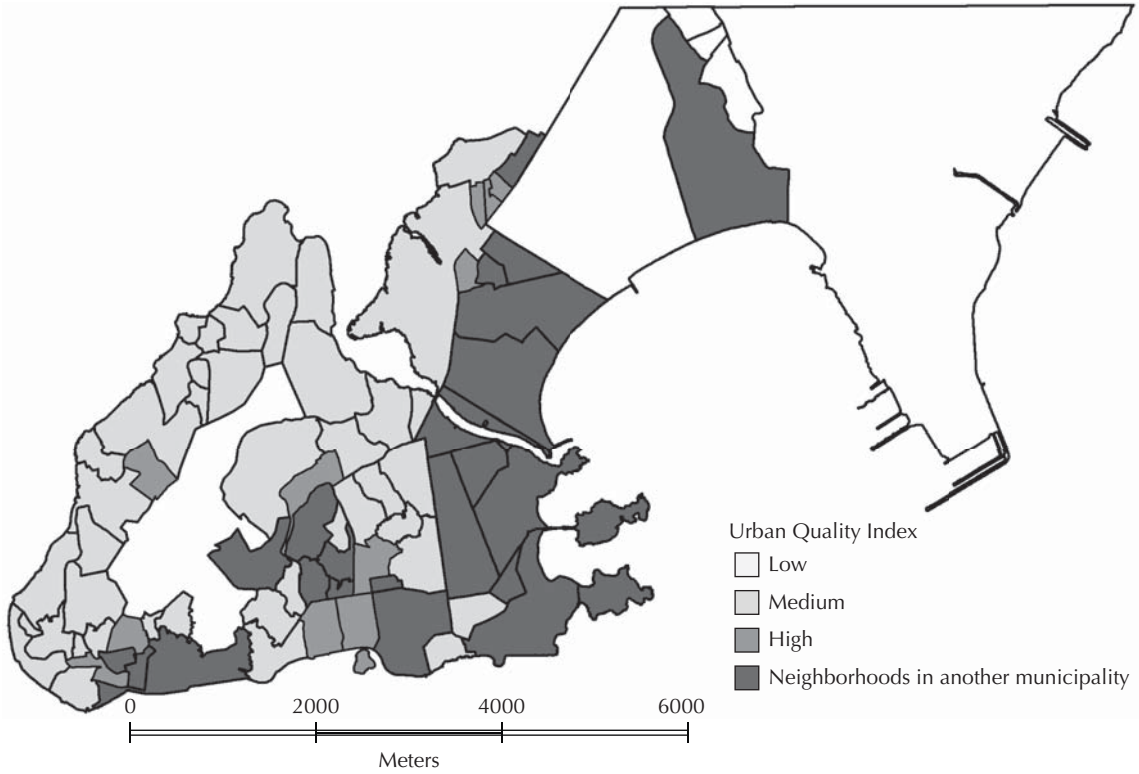
As shown, 42 neighborhoods (53.2%) had low IQU, and São Benedito had the lowest value (0.20). Twelve neighborhoods (15.2%) had medium IQU, and 25 (31.6%) had high IQU, with Santa Helena having the highest value (0.84).

Between 2000 and 2006, HIV infection in pregnant women was reported in the majority of neighborhoods in Vitória, although at different prevalence (Figure 3). Six neighborhoods had very high prevalence (Universitário 2.35%, Monte Belo 2.29%, São Pedro 2.01%, Ilha do Príncipe 1.51%, Piedade 1.23% and Cruzamento 1.49%). Jardim da Penha and Jardim Camburi presented the lowest rates, 0.13% and 0.12% respectively.

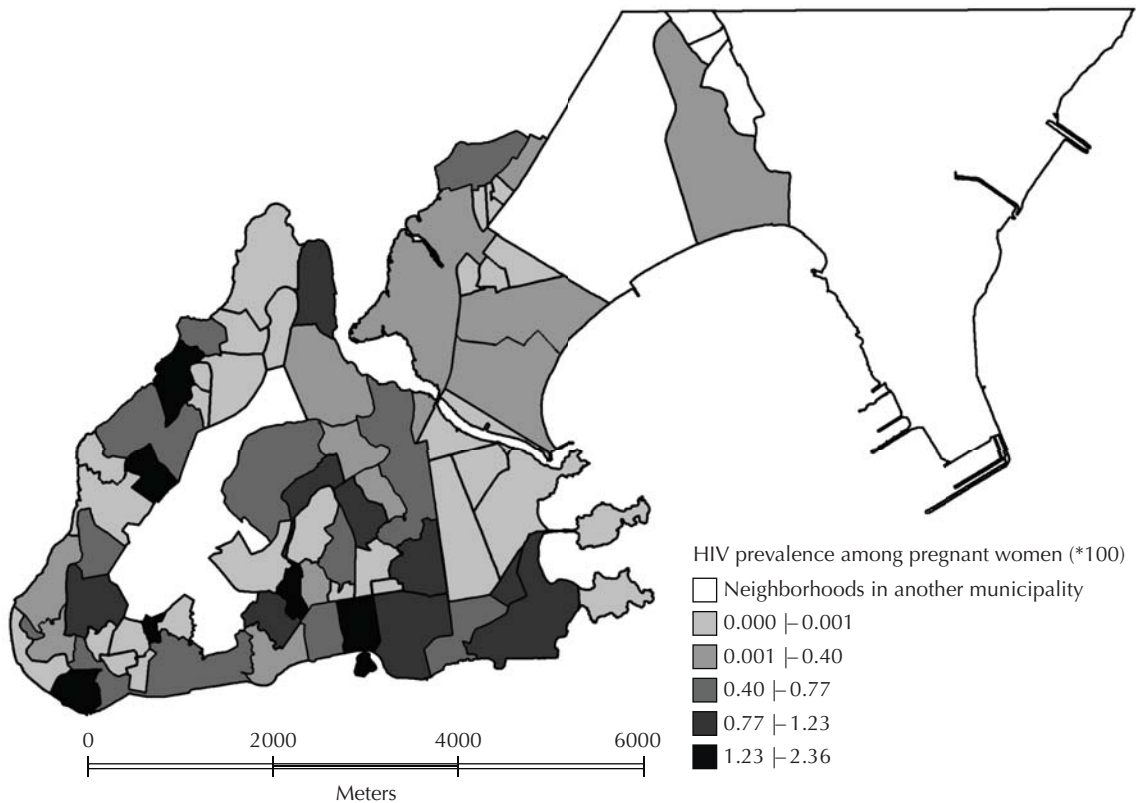
The spatial distribution of children infected by VT (Figure 4) reveals greater frequencies in neighborhoods

**Table 2.** Poisson model considering Urban Quality Index and prevalence of HIV in pregnant women in Vitória, Southeastern Brazil, 2000-2006.

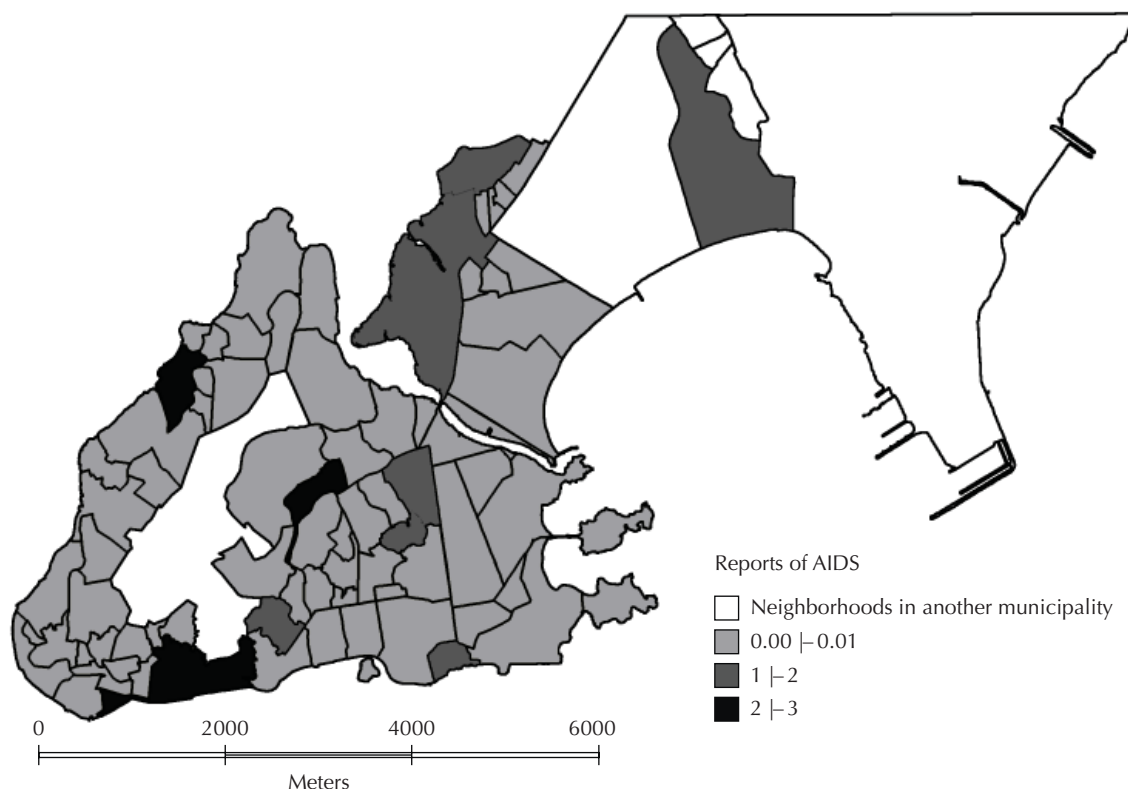
| Model                 | Coefficient | Standard error | Z                        | P> [Z] | 95%CI        |
|-----------------------|-------------|----------------|--------------------------|--------|--------------|
| Urban Quality Index   | -2.819      | 0.620          | -4.54                    | 0.000  | -4.035;1.602 |
| Pregnant Women        | 0.001       | 0.000          | 7.62                     | 0.000  | 0.000;0.001  |
| Constant              | 1.405       | 0.302          | 4.65                     | 0.000  | 0.813;1.997  |
| LR $\chi^2$ (2)=58.66 |             |                | Prob > $\chi^2$ = 0.0000 |        |              |



**Figure 2.** Distribution of neighborhoods in Vitória, according to the Urban Quality Index. Vitória, Southeastern Brazil, 2000.



**Figure 3.** Prevalence of HIV-infection among pregnant women, distributed by neighborhood. Vitória, Southeastern Brazil, 2000-2006.



**Figure 4.** Neighborhood distribution of AIDS cases from vertical transmission in children less than 13 years. Vitória, Southeastern Brazil, 2000-2006.

of lower urban quality. Considering the 14 notifications, of ten neighborhoods with VT only three (30%) had high IQU.

Considering the 14 notifications of VT (9.7% VT rate), 64.3% of cases corresponded to low urban quality neighborhoods, 14.3% medium quality and 21.4% high quality. In analysis of the seven notifications (5.0% VT rate), 85.7% were from low IQU neighborhoods and 14.3% from high IQU neighborhoods. Underreporting is greater for residents of neighborhoods with low urban quality.

Poisson regression shows an inverse association between the IQU variable and prevalence rate of HIV-infection in pregnant women (Table 2): the lower the IQU level, the greater the infection prevalence among pregnant women.

## DISCUSSION

An HIV prevalence of 0.44% was found among pregnant women in Vitória, similar to the rate in Brazil, which estimate among pregnant women was 0.41% in 2004.<sup>17</sup> Studies in other states in Brazil and in Vitória report rates from 0.42% to 0.50%<sup>6,8,12,15</sup> Nonetheless, prevalence in the current study is less than the 0.6% found in public maternity hospitals of Vitória by

Miranda et al.<sup>13</sup> The difference may be to the fact that these maternities attend pregnant women from other municipalities in the state.

The HIV VT rate found in this study (between 5.0% and 9.7%) is within the range reported by various other studies, from 0.1% to 27.2%,<sup>8,13,15,16,18,19,21</sup> and does not differ from the 6.8% estimated for Brazil and 7.6% for the Southeast Region in 2004.<sup>17</sup> Nonetheless, since the highest rates occur in pregnant women that do not undergo preventive interventions, which can reduce VT to less than 0.5%,<sup>7</sup> these levels are far from ideal.

Although Vitória has a prenatal care rate of approximately 95%, a previous study<sup>14</sup> reported that the quality of prenatal care in municipal public maternities was unsatisfactory, with difficulty to reduce the proportion of caesarian sections even in maternities that principally care for low risk women, with a low enrollment rate in the low income population and less than six prenatal visits recommended by the Ministry of Health. In addition, non-performance of prenatal care was associated with low education, single marital status and premature birth.<sup>14</sup> The low quality of care may reflect difficulty in early detection of HIV-positive mothers and introduction of prophylaxis to prevent VT, which may be responsible for the high VT rate identified by the present study.



The epidemic dynamic in Vitória is similar to Brazil, with similar rates of VT and HIV-infection among pregnant women. In addition, in neighborhoods with low IQU, based on level of education among pregnant women, prevalence was higher, indicating a pauperization of AIDS.<sup>4,10,11</sup> Use of neighborhood as the unit of analysis emphasized the internal differences in the city and its social and epidemiologic processes, with a tendency for an increased epidemic among women located in poorer neighborhoods, as in a study performed in Rio de Janeiro State (Southeastern Brazil).<sup>19</sup>

The main study limitation was the quality of data available in databases of HIV in pregnant women and of AIDS in children less than 13 years, which were shown to be incomplete and inconsistent. The greatest obstacle was the discrepancy between the databases, with seven

mothers unreported in Sinan due to under-notification of HIV-positive pregnant women and a consequent under-estimation of the VT rate. Due to the importance of these indicators, it is urgent to improve notification by linking each child infected by VT with the respective notification of their HIV-positive mother. In addition, the small number of events may have impacted data analysis due to the substantial amount of neighborhoods with no events.

Neighborhood socioeconomic condition, summarized by the IQU, was associated with HIV prevalence among pregnant women in the current study. Geoprocessing improved visualization of cases, revealing concentrations in neighborhoods with lower urban quality, allowing municipal managers and health professionals to act aggressively in the most vulnerable areas.

## REFERENCES

1. Barcellos C, Bastos FI. Geoprocessamento, ambiente e saúde: uma união possível? *Cad Saude Publica*. 1996;12(3):389-97. DOI:10.1590/S0102-311X1996000300012
2. Barcellos C, Ramalho WM, Gracie R, Magalhães MAFM, Fontes MP, Skaba D. Georreferenciamento de dados de saúde na escala sub-municipal: algumas experiências no Brasil. *Epidemiol Serv Saude*. 2008;17(1):59-70. DOI: 10.5123/S1679-49742008000100006
3. Barcellos C, Acosta LMW, Lisboa EP, Britto MRV, Flores R. Estimativa da prevalência de HIV em gestantes por análise espacial, Porto Alegre, RS. *Rev Saude Publica*. 2006;40(5):928-30. DOI:10.1590/S0034-89102006005000007
4. Bastos FI, Szwarcwald CL. AIDS e pauperização: principais conceitos e evidências empíricas. *Cad Saude Publica*. 2000;16 Suppl 1:65-75. DOI:10.1590/S0102-311X2000000700006
5. Bastos MJRP, Pereira JA, Smarzarzo DC, Costa EF, Bossanel RCL, Oliosa DMS, et al. Análise ecológica dos acidentes e da violência letal em Vitória, ES. *Rev Saude Publica*. 2009;43(1):123-32. DOI:10.1590/S0034-89102009000100016
6. Cardoso AJC, Griep RH, Carvalho HB, Barros A, Silva SB, Remien RH. Infecção pelo HIV entre gestantes atendidas nos centros de testagem e aconselhamento em Aids. *Rev Saude Publica*. 2007;41 Suppl 1:101-8. DOI: 10.1590/S0034-89102007000900016
7. Connor EM, Sperling RS, Gelber R, Kiselev P, Scott G, O'Sullivan MJ, et al. Reduction of maternal-infant transmission of human immunodeficiency virus type 1 with zidovudine treatment. Pediatric AIDS Clinical Trials Group Protocol 076 Study Group. *N Engl J Med*, 1994; 331:1173-1180.
8. Fernandes RCSC, Araújo LC, Medina-Acosta E. O desafio da prevenção da transmissão vertical do HIV no Município de Campos dos Goytacazes, Rio de Janeiro, Brasil. *Cad Saude Publica*. 2005;21(4):1153-9. DOI:10.1590/S0102-311X2005000400017
9. Fonseca MG, Bastos FI. Twenty-five years of the AIDS epidemic in Brazil: principal epidemiological findings, 1980-2005. *Cad Saude Publica*. 2007;23 Suppl 3:S333-44. DOI:10.1590/S0102-311X200700150000
10. Fonseca MGP, Bastos FI, Derrico M, Andrade CLT, Travassos C, Szwarcwald CL. AIDS e grau de escolaridade no Brasil: evolução temporal de 1986 a 1996. *Cad Saude Publica*. 2000;16 Suppl 1:77-87. DOI:10.1590/S0102-311X2000000700007
11. Fonseca MGP, Szwarcwald CL, Bastos FI. Análise sociodemográfica de Aids no Brasil, 1989-1997. *Rev Saude Publica*. 2002;36(6):678-85. DOI: 10.1590/S0034-89102002000700004
12. Lemos LMD, Gurgel RQ, Dal Fabbro AL. Prevalência da infecção por HIV em parturientes de maternidades vinculadas ao SUS. *Rev Bras Ginecol Obstet*. 2005;27(1):32-6. DOI:10.1590/S0100-72032005000100007
13. Miranda AE, Rosetti Filho E, Trindade CR, Gouvêa GM, Costa DM, Oliveira TG et al. Prevalência de sífilis e HIV utilizando testes rápidos em parturientes atendidas nas maternidades públicas de Vitória, Estado do Espírito Santo, *Rev Soc Bras Med Trop*. 2009;42(4):386-91. DOI:10.1590/S0037-86822009000400006
14. Miranda AE, Trindade CR, Nunes RH, Marba EF, Fernandes MC, Quarto GHA, et al. Factors associated with prenatal care and seeking assistance in public hospitals in Vitória, Espírito Santo, Brazil. *Women Health*. 2010;50(3):229-40. DOI:10.1080/03630242.2010.480904
15. Miranda AE, Figueiredo NC, Soares RA, Monteiro RB, Prado BC. Mother to child transmission of HIV in Vitoria, Brazil: Factors associated with lack of HIV prevention. *AIDS Care*. 2005; 17: 721-728. DOI:10.1080/09540120500038033
16. Nishimoto TMI, Eluf Neto J, Rozman MA. Transmissão materno-infantil do vírus da imunodeficiência humana: avaliação de medidas de controle no município de Santos. *Rev Assoc Med Bras*. 2005;51(1):54-60. DOI: 10.1590/S0104-42302005000100021
17. Succi RCM. Mother-to-child transmission of HIV in Brazil during the years 2000 and 2001: results of a multi-centric study. *Cad Saude Publica*. 2007;23 Suppl 3:379-89. DOI:10.1590/S0102-311X2007001500006
18. Souza Júnior PRB, Szwarcwald CL, Barbosa Junior A, Carvalho MF, Castilho EA. Infecção pelo HIV durante a gestação: estudo-Sentinelas Parturiente, Brasil, 2002. *Rev Saude Publica*. 2004;38(6):764-72. DOI: 10.1590/S0034-89102004000600003
19. Tess BH, Rodrigues LC, Newell ML, Dunn NT, Lago TDG. Breastfeeding, genetic, obstetric and other risk factors associated with mother-to-child transmission of HIV-1 in São Paulo State, Brazil. *AIDS*. 1998;12(5):513-20.
20. Tomazelli J, Czeresnia D, Barcellos C. Distribuição dos casos de AIDS em mulheres no Rio de Janeiro, de 1982 a 1997: uma análise espacial. *Cad Saude Publica*. 2003;19(4):1049-61. DOI:10.1590/S0102-311X2003000400027
21. Vasconcelos ALR, Haman EM. Por que o Brasil ainda registra elevados coeficientes de transmissão vertical do HIV? Uma avaliação da qualidade da assistência prestada a gestantes/parturientes infectadas pelo HIV e seus recém-nascidos. *Rev Bras Saude Mater Infant*. 2005;5 (4):483-92. DOI: 10.1590/S1519-38292005000400012

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